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Assessment of Ogan River Water Quality Kabupaten OKU South Sumatera by NSF-WQI Method

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Abstract

A Study of physicochemical and microbiology analysis in Ogan River Kabupaten Ogan Komering Ulu was carried out in Mei-June 2016. The purpose of this study was to determine the water quality status of Ogan River in Kabupaten OKU South Sumatra. There are several methods can be used in doing the assessment for water quality of a river. The National Sanitation Foundation Water Quality Index (NSF-WQI) will be used in this study. Water quality status was studied at six selected stations to represent different localities with varying anthropogenic discharge. Water samples were taken by purposive sampling method. Physicochemical and microbiology parameters of samples were measured pH, temperature, Turbidity, Total Suspended Solids, Dissolved Oxygen, Biochemical Oxygen Demand, nitrate, Phosphate, and Fecal Coliform following standard method. The result is the river water quality status is medium; the value ranged 56-57. Based on these indices it is concluded that the anthropogenic activities along Ogan River affected the quality of water Ogan River.

Keywords: Ogan River, Water Quality, NSF-WQI

Abstrak (Indonesian)

Penelitian mengenai kualitas air Sungai Ogan, Kabupaten Ogan Komering Ulu dengan cara menganalisis faktor fisika, kimia dan biologi air sungai Ogan telah dilakukan pada bulan Mei-Juni 2016. Tujuan penelitian ini adalah menentukan status kualitas air Sungai Ogan di Kabupaten OKU Sumatera Selatan. Ada beberapa metode yang dapat dipakai untuk mengetahui kualitas air suatu perairan. Dalam penelitian ini, metode yang akan dipakai adalah metode National Sanitation Foundation-Water Quality Index (NSF-WQI). Ada enam lokasi titik sampling yang dipilih dengan metode purposive sampling. Ada sembilan parameter fisika, kimia dan biologi yang diukur, yaitu suhu, kekeruhan, TSS, pH, DO, BOD, Nitrat, fosfat dan coliform. Hasilnya untuk status kualitas air Sungai Ogan adalah medium atau tercemar sedang dengan nilai berkisar 56-57. Berdasarkan hasil yang didapat, disimpulkan bahwa aktivitas masyarakat di sepanjang sungai Ogan memberikan pengaruh pada kualitas air sungai Ogan.

Kata Kunci: Sungai Ogan, Kualitas Air, NSF-WQI

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INTRODUCTION

A clean river without contamination is a vital thing for life. Since along ago, river has an important role in human life, for drinking water, irrigation, etc. The river deserves attention, to keep its water quality, so it can be used properly and continuously, as discussed by Marganingrum [8]. In many develop and under develop countries, the river is used as a station of waste, either domestic or industries waste. The waste contains many pollutants that contribute to the degradation of river's water quality, as discussed by Effendi [5].

Ogan river is the biggest river in Kabupaten OKU, it's length is 170 km. Ogan river divides

Baturaja City into Baturaja Barat and Baturaja Timur. Ogan river flows through many villages, which are Pasar, Kebun Jati, Kemalaraja, Air Gading, Pangeran Hajib, Sukajadi, and some other villages in Kabupaten OKU. Ogan river water is used for drinking water, household activities, irrigation and fishing plantation. Even more become water intake for Perusahaan Air Minum Baturaja. Along DAS Ogan river, there are many farming land activities, Rumah Sakit Umum Daerah Ibnu Sutowo, home industries such as tahu and tempe, car washing, and big industries such as PT Minanga Ogan and PT Pertamina Geothermal Energi. Waste water from these industries and domestic sewage along Ogan River will affect the water quality of Ogan river. Because of this reason, an assessment to verify water quality of Ogan river is needed. The aim of this study is to assess status of Ogan river water quality based on the National Sanitation Foundation-Water Quality Index method, whether Ogan river water is acceptable for various purposes as domestic use, agriculture, and even drinking.

MATERIALS AND METHODS

Sampling Activity

Water samples were taken from Ogan river, Kabupaten OKU INDUK, South Sumatra. Samples were taken from six different stations. The stations were selected due to purposive sampling method. Then the geographical location of the sampling stations was determined by GPS. Table 1 and 2 show the geographical coordinates of the selected stations. The positions of the sampling stations are also shown in Figure 1.

Table 1. Sampling Location Coordinates in Ogan River

Stations	Latitude	Longitude
station 1	04° 14' 53.1"	104° 16' 04.4"
station 2	04° 14' 50.9"	104° 16' 13.6"
station 3	04° 13' 06.7"	104° 16' 50.8"
station 4	04° 12' 33.0"	104° 16' 68.2"
station 5	04° 11' 30.2"	104° 17' 07.3"
station 6	04° 10' 13.6"	104° 17' 44.0"

Sampling activities were done twice at low tide and high tide. Water samples were collected on May – June 2016. Samples were collected by grab sampling method and measured both in-situ and ex-situ (BTKL Laboratory Palembang) with standard prosedures

Table 2. Standard used in measuring water quality

Parameters	Unit	Method
pH	-	SNI 06.6989.11-2004
Temperature	°C	SNI 06.0689.23-2005
Turbidity	NTU	SNI 06.6989.25-2005
Total Suspended Solid	mg/L	SNI 06.6989.3-2004
Dissolved Oxygen	mg/L	SNI 06.6989.14.2004
Biochemical Oxygen Demand	mg/L	SNI 06.6989.57-2008
Nitrate	mg/L	SNI 06.2480.1991
Phosphate	mg/L	SNI 06.6989.17-2009
Fecal Coliform	N/100 mL	SNI 01.2897.1992

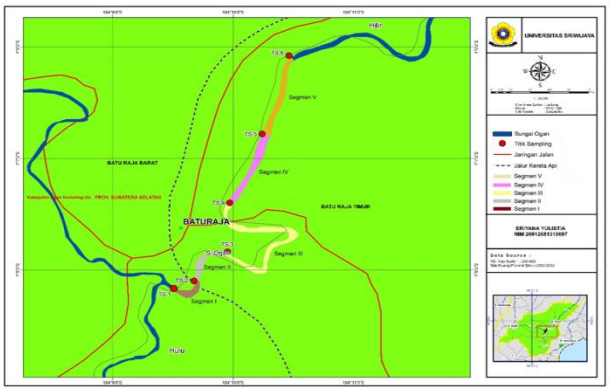

Figure 1. The Position of Sampling Station

Calculating the Index

In this study, calculation of NSFWQI index used the online NSFWQI Calculator Software (http://www.water-research.net/watrqualityindex/index.htm). Then it will be summed with the following equation:

$$WQI = \Sigma_{(i=1)}^{n} Qi\ Wi \quad (1)$$

Whereas:
WQI = Water Quality Index
Qi = Index Quality
Wi = Weight or degree of priority of the factor
n = Total Parameter

Then the NSF Water Quality Index of samples were confirmed according to NSF WQI Legend Table as shown in Table 3.

Base on the South Sumatra Governor Provision No 16/2005 (class I), water quality for drinking, will be used as standard quality.

Table 3. NSF-Water Quality Index Legend

Water Quality Range	Index Legend Quality
90-100	Excellent
70-90	Good
50-70	Medium
25-50	Bad
0-25	Very bad

RESULT AND DISCUSSION

Temperature

Temperature pattern in an aquatic ecosystem is altered by many factors, such as whether, humidity and sunlight exposure [6]. Temperature has significant influence on the aquatic ecosystem. Most of the aquatic animals and plants survive in a certain range of temperatures but not tolerate extreme changes [10].

The Temperature in Ogan River is ranging from 26 0C to 28 0C during low tide and high tide, and it was considered in a good condition. Sunlight exposure is probably the main factor that holds big effect that influences water temperature. According to South Sumatra Governor Regulation no 16/2005, defines temperature deviation is 3 °C. So, the temperature in Ogan River's water in six stations still meet the quality standard, both in low tide and high tide.

Turbidity

Turbidity caused by impurities may include: clay and silt (runoff), organic and inorganic matter (by discharged waste), microorganism and other organic lives [11]. High level of turbidity has a bad influence on the aquatic ecosystem. High level of turbidity will make sunlight exposure cannot penetrate the water. Turbidity is calculated by using light scattering in water column due to suspended solids. High turbidity will cause more water darkness. If water became very dull, it's ability in maintaining most of plants and organisms will be removed [4].

Turbidity of water in Ogan River ranged 11-26 NTU. Turbidity in upstream of Ogan River is higher than turbidity in downstream. This is affected by cultivation activity that contributes to soil loss runoff, thus increase turbidity of the water in upstream area of Ogan River. But, in downstream area, these soil articles sedimentation. Turbidity is one of an abiotic factor that related to sedimentation [2].

Total Suspended Solids

TSS in Ogan River ranged from 10-19 mg/L. The highest TSS is found in upstream and the lowest is found in downstream area. TSS is followed by turbidity linearly. There exists a little relationship between the value of turbidity and total solid [2]. According to the South Sumatra Governor Regulation no 16/2005, TSS in Ogan River still met the quality standard.

pH

pH is one of the most important factors that serves an index for the pollution [1]. pH has direct effect on life in the ecosystem. pH effects nutrients absorbance by organism. pH under 4.8 and above 9.2 is lethal to many aquatic organisms [3]. pH of water in Ogan River ranged 6.8-7.7. According to South Sumatra Governor Regulation no 16/2005, the quality standard for pH is 6-9 (Class I), that means pH in Ogan River water still fulfilled the standard.

Dissolved Oxygen

Oxygen is needed by aquatic organisms for respiration. Unpolluted river DO level is ranged between 80%-100% [5]. DO concentration below 5 mg/L may adversely affect the performance and survival of biological communities, and below 2mg/L may lead to fish mortality. Water without adequate DO may consider wastewater [1].

The highest DO level is found in station 2. Station 2 is an area which its substance is rock and the stream flow higher. Water turbulence in upstream has been effective increasing DO level [6]. According to Governor's provision, the minimum threshold value for DO is 6 mg/L. Station 3,4,5,6 didn't reach the quality standard.

Biochemical Oxygen Demand

BOD is measured based on the amount of oxygen consumed by bacteria which are found in water. Bacteria consumed organic materials and reduce the oxygen in water [4]. The highest BOD in Ogan River reached 1.64 mg/L, and the lowest BOD is 1.18 mg/L. The threshold value maximum for BOD according governor's provision is 2 mg/L. All sampling stations met the standard value. In rivers, BOD value above 3 mg/L indicates the domestic sewage pollution throw out the river stream [11].

Table 4. Water Quality of Ogan River in High Tide

No	Parameters	Unit	Stations					
			1	2	3	4	5	6
1.	Temperature	^{0}C	26	27	26	27	27	26
2.	Turbidity	NTU	26.7	24.7	22.3	18.3	16.2	17.1
3.	TSS	mg/L	19.3	19.3	19.7	16.3	12.0	13.7
4.	pH	-	7.6	7.0	7.1	7.3	7.5	7.7
5.	DO	mg/L	6.2	6.9	5.7	4.6	5.2	5.5
6.	BOD	mg/L	1.18	1.48	1.64	1.47	1.62	1.62
7.	Nitrate	mg/L	0.06	0.03	0.12	0.09	0.12	0.17
8.	Phosphate	mg/L	0.06	0.08	0.16	0.2	0.16	0.1
9.	Coliform	N/100 mL	940	933	900	1433	1400	1500

Table 5. Water Quality of Ogan River in Low Tide

No	Parameter	Unit	Stations					
			1	2	3	4	5	6
1.	Temperature	^{0}C	27	27	27	28	28	28
2.	Turbidity	NTU	18.7	17.3	13.2	12.3	11.5	11.3
3.	TSS	mg/L	15.3	13.7	10.1	11.3	12.3	11.8
4.	pH	-	6.8	7.0	7.2	7.2	7.3	7.3
5.	DO	mg/L	5.5	6.0	4.8	4.7	3.7	4.2
6.	BOD	mg/L	1.49	1.5	1.6	1.6	1.6	1.5
7.	Nitrate	mg/L	0.2	0.1	0.06	0.1	0.04	0.03
8.	Phosphate	mg/L	0.04	0.06	0.2	0.22	0.21	0.2
9.	Coliform	N/100 mL	965	1067	1033	1500	1489	1533

Nitrate

Nitrate concentration in Ogan River ranged 0.03-0.2 mg/L. The highest nitrate concentration is found in station 1. In this area, there is tofu industry, carwash and agriculture. Diffuse pollution might occur by domestic wastewater and agricultural landscape drainage water, causing an increase of nitrate and organic matters in water [12]. As more land converted to agricultural site, pollution of nitrate was expected to be increased in recent years [7]. According to South Sumatra Governor Regulation no 16/2005, standard quality threshold for nitrate is 0.5 mg/L maximum. Hence, the water still meets the criteria required.

Phosphate

Phosphorus is a component of sewage, as the element is essential in metabolism, and it is always present in the animal metabolic waste. Phosphorus occurs in its fully oxidized (phosphate) state in water [2]. Phosphate concentration in Ogan River is ranged between 0.04-0.22 mg/L. The highest concentration is found in station 4. Station 4 is dominated by urban residence. According to South Sumatra Governor Provision no 16/2005, quality standard for phosphate is 0.2 mg/L (class I). So, phosphate concentration in station 4 have reached the limit (high tide). In low tide, station 3, 4, 5, 6 has reached the limit.

Fecal coliform

Coliform bacteria are indicator organism for the presence of pathogens in the water samples. The result from laboratory showed that all water samples from Ogan River have covered the standard quality in South Sumatra Governor Provision no 16/2005. The highest concentration of coliform was found in station 6, which reached 150/ml in high tide. While in low tide, coliform reached 153/ml. The high levels of fecal coliforms indicated the entry of sewage water [6].

Ogan River Quality Status According to NSF QWI

Based on the analysis using NSF WQI, Ogan River water classification in each station is presented at Table 6. The quality of the water at every station was

almost the same. The NSF WQI score ranged 55-56 and can be classified as medium.

Table 6. NSF WQI classification for Ogan River
A. Ogan River NSF WQI classification in high tide

Station	NSF WQI Score	Classification
1	56	medium
2	55	medium
3	55	medium
4	55	medium
5	55	medium
6	55	medium

B. Ogan River NSF WQI classification in low tide

Station	NSF WQI Score	Classification
1	55	medium
2	55	medium
3	56	medium
4	55	medium
5	55	medium
6	55	medium

Parameters which are out of South Sumatra Governor provision no 16/2005 (class I) were DO, Phosphate and Fecal Coliform. That might due to anthropogenic activities, especially habits of people who lives along Ogan River using Ogan River as drainage.

CONCLUSION

Based on NSF WQI, water quality in Ogan River has been classified as medium. There are some parameters reaching out the South Sumatra Governor Provision no 16/2005 (class I). Those parameters were DO at station 3, 4, 5, 6; Phosphate at station 3, 4, 5, 6; Fecal Coliform at all sampling stations. This condition shows that the anthropogenic activities along Ogan River have affected the quality of water in Ogan River.

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